

EXTENSIVE SPINAL EPIDURAL HEMATOMA REMOVED BY A MULTILEVEL BILATERAL ALTERNATING HEMI-LAMINECTOMY

A.E.K. MOUMOUNI MD¹, P. COMPAORE MD¹, D. MEMIAZOLO MD¹, S. MOUCHARRAFI MD¹, A. HAMLAT, MD¹

Department of Neurosurgery, CHU MARTINIQUE

ABSTRACT : *Objective and Importance :* Extensive spinal epidural hematoma (SEH) creates another treatment challenge because the aim of surgery is to remove the hematoma without devastating damage to the spine. We report herein, to the best of our knowledge, the first case of extensive SEH treated by a multilevel bilateral alternating hemi-laminectomy which may reduce the potential risk of associated spinal deformity often linked to multilevel laminectomy. *Clinical Presentation :* A 49 year-old woman was admitted to our Department for flaccid paraplegia. An emergent MRI showed an elongated spindle shaped lesion at the dorsal epidural space extending from T1 to T12, suggestive of SEH, with the most compressive bulk of the lesion extending from T3 to T9. *Technique :* The hematoma was successfully removed via a bilateral alternating hemilaminectomy, involving successively one lamina and the underneath opposite lamina, from T4 to T8. *Conclusion :* Extensive posterior SEH could be managed by bilateral alternating hemi-laminectomy, in place of devastating laminectomy which impairs the stability of the posterior vertebral column and predispose to spinal instability and deformity, notably in childhood.

Key words : Spinal epidural hematoma ; Bilateral alternating hemi-laminectomy ; Surgical technique.

INTRODUCTION

Spinal epidural hematoma (SEH) is a rare neurosurgical emergency. It has been reported in all age groups but most frequently after the fourth or fifth decade [1, 2]. The two prevalent sites of SEH are the cervico-thoracic and the thoraco-lumbar junctions; the first site is prevalent within all age groups while the thoraco-lumbar junction is the second prevalent site between the fifth and eighth decade [1, 2]. Usually SEH extends over two to five segments [2-6] but extensive forms affecting as many as eight segments to the entire spinal canal have been described both in childhood [7-10] and adults [11-22]. These extensive forms create another challenge, for spine surgeons, because the aims of surgery are to remove the hematoma and to improve or preserve neurological functions without excessive and devastating damage to the spine. Thus, neurosurgeons should consider the potential risk of associated spinal deformity and spinal motion disorders of an extensive emergent surgical decompressive multilevel laminectomy. We report herein,

to the best of our knowledge, the first case of extensive SEH treated by a multilevel bilateral alternating hemi-laminectomy and discuss its interests.

CASE REPORT

A 49 year-old woman was awakened, from her sleep at 4:00 a.m, by an acute onset of severe thoracic spinal pain, irradiating to the chest and lumbar region, with simultaneous burn sensation in the abdomen and the chest. Within half an hour she noticed a numbness of her lower extremities, decreased motor sensation, and an inability to move her legs. Her medical history was significant for Hodgkin's disease 30 years ago. She was treated by a primary mantle field irradiation, two cycles of chemotherapy, and splenectomy. Following radiotherapy she developed a hypothyroidism, 10 years later, and she was treated for a coronary artery disease by a per-cutaneous trans-luminal coronary angioplasty in 2007 and permanent 200 mg/ day of Aspirin. In addition she did recall, 4 days before the onset, a fall from height on his buttocks but she had not experienced any pain.

First seen at local hospital, thoraco-abdominal CT scan was performed in consideration of a suspicious aortic dissection. The non enhanced CT scan showed a spontaneous hyper-dense epidural lesion at T5-T6 level with spinal cord compression.

She was then referred to our Department ; neurological examination revealed a complete flaccid paraplegia with a bilateral T5 pinprick sensory level; disturbance in micturiation and altered anal sphincter tone were noted. The paraplegia was graded Frankel A. Upper extremities and cranial nerves were normal. No external signs of trauma were noted during physical examination, which revealed thoracic paraspinal muscles atrophy with important sub-cutaneous exteriorization of thoracic spinous processes; this was identified as a coexisting pre-morbid condition for spine instability.

Laboratory examinations, including prothrombin time, partial thromboplastin time, platelet count, and liver function tests were unremarkable.

An emergent MRI showed an elongated spindle shaped lesion at the dorsal epidural space extending from T1 to T12 (Fig. 1). Axial MRI disclosed a clear separation between the posterior hematoma and the spinal cord, evocative of SEH (Fig. 2). There was no hematoma enhancement following gadolinium infusion.



Fig 1: (A): Sagittal T2 weighted MRI shows the cervical part of the hematoma visible from T1 while the most compressive part starts from T3. The hematoma discloses heterogeneous iso hypo signal intensity. **(B):** Sagittal T2 weighted MRI shows the thoracic part of the hematoma extending to T12; the most compressive part of the hematoma bulk is upper T9.

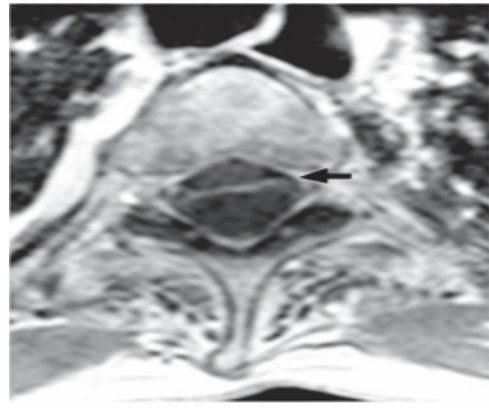


Fig 2: Axial T1 weighted MRI shows the posterior hematoma compressing anteriorly the spinal cord. A clear demarcation, representing the dura mater, is seen between the hematoma and the spinal cord

Surgery : She was operated on 6 hours after onset (AH). In view of the extensive length of the hematoma, midline skin incision, centered at the site of the most compressive hematoma as disclosed by MRI, was performed from T2 to T10. The fascia over the spinous process was incised bilaterally and the atrophic para-spinous muscles were stripped sub-periostally exposing the laminas of the vertebral arches, on both sides, from T3 to T9. A bilateral alternating hemi-laminectomy involving successively one lamina and the underneath opposite lamina was performed from T4 to T8; each hemi-space was opened wider by performing a sus and sub hemi-flavectomy with respect of the medial part of the ligamentum flavum and the spinous process–ligament complex (Fig 3).



Fig 3: 3 D CT scan reconstruction shows the bilateral alternating hemi laminectomy extending from T4 to T8.

Blood clots beneath the preserved hemi laminas were removed by gentle aspiration with a compliant small sucker and a micro-curette. A free soft ventricular catheter was thereafter inserted, underneath the laminas, in the epidural space above and below the limits of the bilateral alternated hemi-laminectomy, to aspirate the remaining fluid filled hematoma. No active bleeding was found and brisk dural pulsations returned at the end of surgery. Partial resection of spinous process with respect of the supra and inter-spinous ligaments from T2 to T10 was finally performed to avoid post operative wound complications, owing to the para-spinous muscles atrophy. Before closure, 2 para spinal drains were placed on both sides, above the laminas and across the hemi-laminectomy, to prevent hematoma re-accumulation on the operative site. Surgery time-span from incision to closure was 2h30 while spinal cord decompression was achieved 1h 45mn after skin incision.

Histopathological study of the surgical samples was consistent with a hematoma. No vascular disease or tumor was disclosed.

Post operative MRI showed complete hematoma resolution (Fig 4, 5). No neurological improvement was noted after surgery and the patient was referred to rehabilitation center 1 week later. At 5 months and 1 year follow up the neurological examination remained unchanged (Frankel grade A) except for lower extremities spasticity. No spinal deformity was observed on clinical examination.

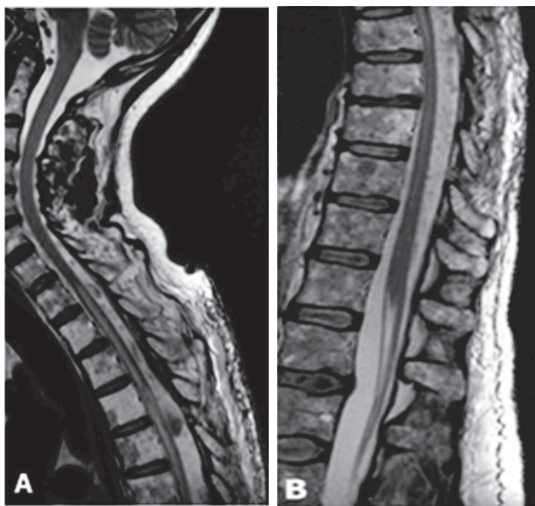


Fig 4: (A) Sagittal T2 weighted MRI shows the total removal of the hematoma at both cervical and (B) thoracic levels. There is a spinal cord hyper-signal extending from T1 to T8. The intense flow void demonstrates a complete spinal cord decompression with restoration of cerebro spinal fluid flow.

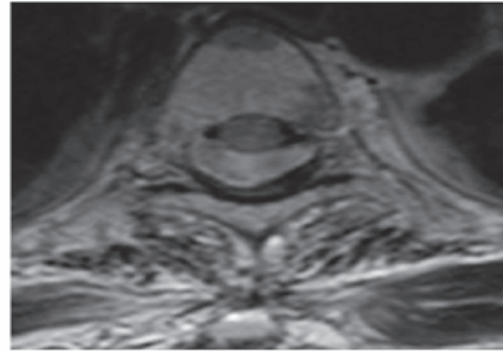


Fig 5: Axial T2weighted MRI shows the total spinal cord decompression and the restoration of the spinal sub-arachnoid space

DISCUSSION

In most cases, spontaneous SEH is an unknowable disease by its pathophysiology [1,2, 23] and controversial by its management because the traditional unconditional urgent neurosurgical decompression seems not always mandatory owing to some spontaneous recovery. The necessity of a surgical intervention versus conservative management has widely been discussed in the literature [2, 3, 5, 6, 14, 24, 25] and the length of hematoma can not solely be used as a crucial guide for treatment, because spontaneous recovery also correlates to larger hematomas; so neurological status stills the main indication for surgery [5,9,17,18,22].

Decompressive laminectomy is the first and the most used procedure for SEH removal, in all parts of the spine, independently of patient's age and hematoma extent. However, its widespread use, in spine surgery, has demonstrated that spinal deformity and disability of spinal motion, following multilevel laminectomy, can occur in both the adult and pediatric populations [26-31]. Since, several other surgical modalities have been used for localized SEH removal, including laminectomy with thoraco-lumbar pedicle screw fixation [32] hemi laminectomy, [18] laminoplasty [32] or sided laminoplasty, [33] inter-laminar fenestration or flavectomy [3] costo-transversectomy [34] with pediculectomy [35] anterior corporectomy [36] and anterior cervical dissection [6].

In opposition to the numerous surgical possibilities described for localized SEH, only multilevel laminotomy, [10, 37] broken multilevel laminectomy (i.e. C5-C7, T2-T4, T6-T8) [38], and multilevel unilateral alternating hemi-laminectomy [3] have

been suggested as substitutes, to extensive multilevel laminectomy or hemi-laminectomy, in the treatment of extensive postero-lateral or posterior SEH. Consequently, extensive multilevel laminectomy [8,11-15,19,20,39] and multilevel hemi-laminectomy [7,18], over the most affected segments, have been preferentially performed for removal of such hematomas.

Herein we describe an extension of unilateral alternating hemi-laminectomy, first described by Borm [3]. Uni and bilateral multilevel alternated hemi-laminectomy approaches are likely to suffice to remove totally the majority of extensive hematoma because they are almost exclusively located in the dorsal or dorso-lateral spinal canal. The tendency of posterior SEH to be more extensive in the sagittal plan, in contrast to their anterior counterparts, could be explained by the fact that ventrally, the dural sac is attached anteriorly to the spinal canal by connective tissue strands (thus limiting the sagittal extension of hematomas) whereas dorsally the space is free and filled by fatty tissue [40, 41].

From neurosurgical point of view, fear of consecutive hemi-laminectomy is that they may result in inadequate spinal cord decompression [3]. However we agree with Börm's et al statement: postero-lateral SEH (developed on 4 segments or more) could be removed through unilateral multilevel alternated hemi-laminectomy, involving successively one out of two or three laminae [3]. In contrast extensive dorsal SEH displacing anteriorly the spinal cord, could be rapidly removed through a bilateral multilevel alternating hemi-laminectomy involving successively one lamina and the underneath opposite lamina, and centered at the most compressive identified site, as reported in the present case (Fig 3). Successful removal of the hematoma and extirpation of the clots is usually not hindered by leaving alternatively half of lamina intact because cervical and thoracic laminae are not large. Clots can be removed beneath the lamina by gentle aspiration with a compliant small sucker and a free soft ventricular catheter, inserted in the epidural space (underneath the laminae) above and below the limits of the operative field, allows removing the remaining fluid filled hematoma, as reported in the present case. In posterior SEH, we believe that bilateral alternating multilevel hemi-laminectomy allows adequate spinal cord decompression

on both sides inversely to unilateral approach which may result in inadequate opposite side decompression in view of the blindness of the contra-lateral preserved spinal side. Additionally these techniques may suffice to treat posterior and postero-lateral hematomas without risk, as most often no active bleeding is found at surgery.

In patients with spinal canal stenosis or in lumbar region use of the power drill with polishing diamond burrs may be an essential step in thinning enlarged arthritic laminae and facets, thus allowing the use of more delicate rongeurs to perform hemi-laminectomy. Dural or nerve lacerations are less probable to occur in such cases, because the spinal dura mater is protected by the hematoma.

There are no evidenced-based-guidelines of SEH and the results of treatment from the point of view of post operative spinal deformities have not been evaluated in previous reports.

However we believe that alternating hemi-laminectomy are able to remove extensive dorsally located SEH, with no risk of associated spinal deformities. It is well known that spine is a complex dynamic biomechanical system⁴² and its stability is an interaction of three passive and active sub-systems including: the vertebrae, discs, and ligaments which constitute the passive sub-system; muscles and tendons (surrounding the spinal column) constitute the active sub-system; the nerves and central nervous system constitute the neural sub-system [43]. The safety of uni or bilateral alternating hemi-laminectomy from the point of view of spine stability could be explained by the fact that the spinous process–ligament–muscle complex (SLMC) is restored at the end of surgery, thus reducing the risk of post operative spine deformity. Several authors have outlined the importance of SLMC in preventing spinal deformity,[44, 45], therefore the loss of the integrity of the posterior stabilizing SLMC realized by laminectomy, added eventually to neurological deficits, greatly favor spine deformities. Indeed, spine deformity related paraplegia is a significant fact and it can be assumed that the frequency of deformity relates directly to neurological deficit [46], although, the sequence of events and the reasons for such occurrence are not completely understood, but several factors may play part in this development [47]. So, permanent abrupt or chronic changes in spine biomechanical functions, as realized by multilevel laminectomy associated to

neurological deficits predispose spine to instability and increase the risk of deformities.

PROGNOSIS

Due to the rarity of SEH, there is no Class I data to draw meaningful conclusion, but several reviews have attempted to clarify the factors affecting postoperative out-come and the most important predictors of out-come, for neurological improvement, identified up to now, are the timing of the surgical treatment and the preoperative neurological status [2,4,48,49]. In the present case, no improvement has been observed 12 months later, although the patient was operated on within 6 hours after onset. Changes induced by radiotherapy cause the spinal cord to become more sensitive to compression and have lead to serious spinal cord impairment, as shown by post operative MRI. It has been state that patient who does not recover after surgery, have had axonal lesions [49] ; this has probably occurred in the present case, owing to the acute compression of an irradiated spinal cord. Therefore it could be deduced that previous spinal cord irradiation is a pejorative factor for neurological recovery.

CONCLUSION

Extensive postero-lateral or posterior SEH should be managed by uni or bilateral alternating hemi-laminectomy, because multilevel laminectomy impairs the stability of the posterior vertebral column and predispose to spinal instability and deformity. So, nowadays, extensive laminectomy for SEH removal, anywhere in the spine, should not be longer recommended notably in childhood.

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